

# STORMWATER DRAINAGE REPORT

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UNION HILL SELF-STORAGE AND AUXILIARY PARKING LOT  
REDMOND, WASHINGTON

**July 28, 2016**

***Revised Sept. 29, 2016***

***Revised Nov. 17, 2016***

***Revised Mar. 3, 2017***

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## PROJECT OVERVIEW

### PROPOSED IMPROVEMENTS

The proposed development consists of a new self-storage building with associated parking and an auxiliary parking lot on a 3.02-acre site at Lot 4 of the Union Hill Corporate Center in Redmond, Washington. The site will comprise of 2.28 acres of paved asphalt and sidewalks. The property is zoned MP (Manufacturing Park).

### DESIGN CRITERIA

The City of Redmond utilizes the 2005 Washington State Department of Ecology Stormwater Management Manual for Western Washington (DOE Manual) drainage requirements with amendments per the 2012 City of Redmond Technical Notebook. Stormwater generated on-site will be routed to an existing combination water quality/detention pond (Detention Pond A, Union Hill Metro) that was adequately sized to handle runoff from the project site. Per the Stormwater Drainage Technical Information Report for Regional Detention Pond A, Union Hill Metro Site, by DOWL HKM, dated October 29, 2012, the maximum impervious surface area from the project site that can be routed to the existing combination water quality/detention pond is 105,354 SF. The total impervious surface area from the project site proposed to be routed to the existing facility is only 102,626 SF; therefore, no additional water quality or flow control measures are proposed as part of this development.

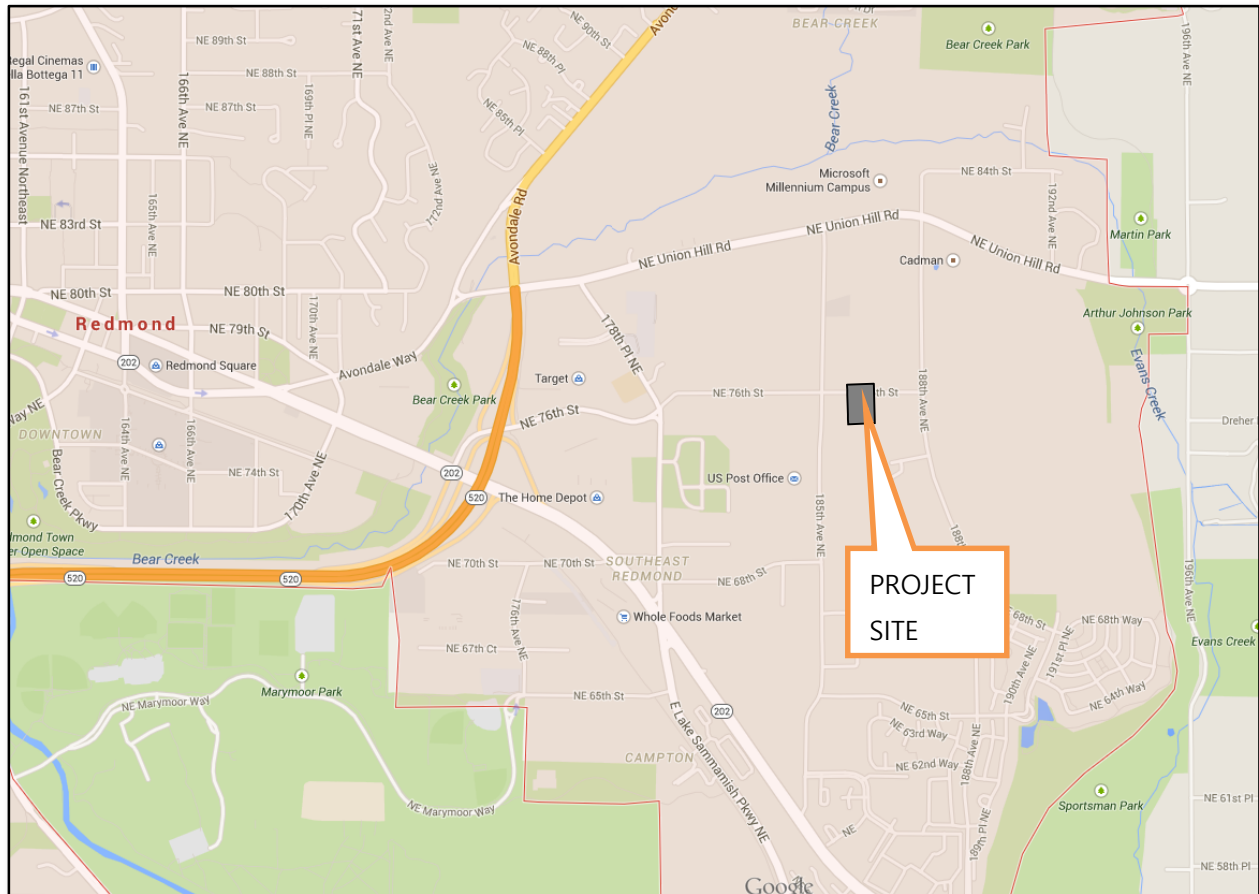
### JURISDICTIONAL REQUIREMENTS

Table 1 below summarizes the DOE Manual stormwater requirements.

**TABLE 1**

Jurisdictional Requirements	
Duration Analysis:	
2-year:	N/A
50-year:	N/A
Water Quality Volume:	N/A
Water Quality Flow Rate:	N/A
Conveyance Analysis:	10-year, 24 hr
Level 1:	¼ mile downstream
Union Hill Corporate Campus Development Agreement and Amendment 1 Maximum Impervious Area Allowed:	105,354 SF
Actual Impervious Area Provided:	102,626 SF

## PROJECT LOCATION



**Figure 1: Vicinity Map**

**Location:** Lot 4 of the Union Hill Corporate Center in Redmond, WA

**Section, Township, Range:** NW  $\frac{1}{4}$ , Section 07, Township 25 N, Range 6 E W.M.

**Parcel Number:** 0725069142

**Size:** 131,692 SF (3.02 AC)

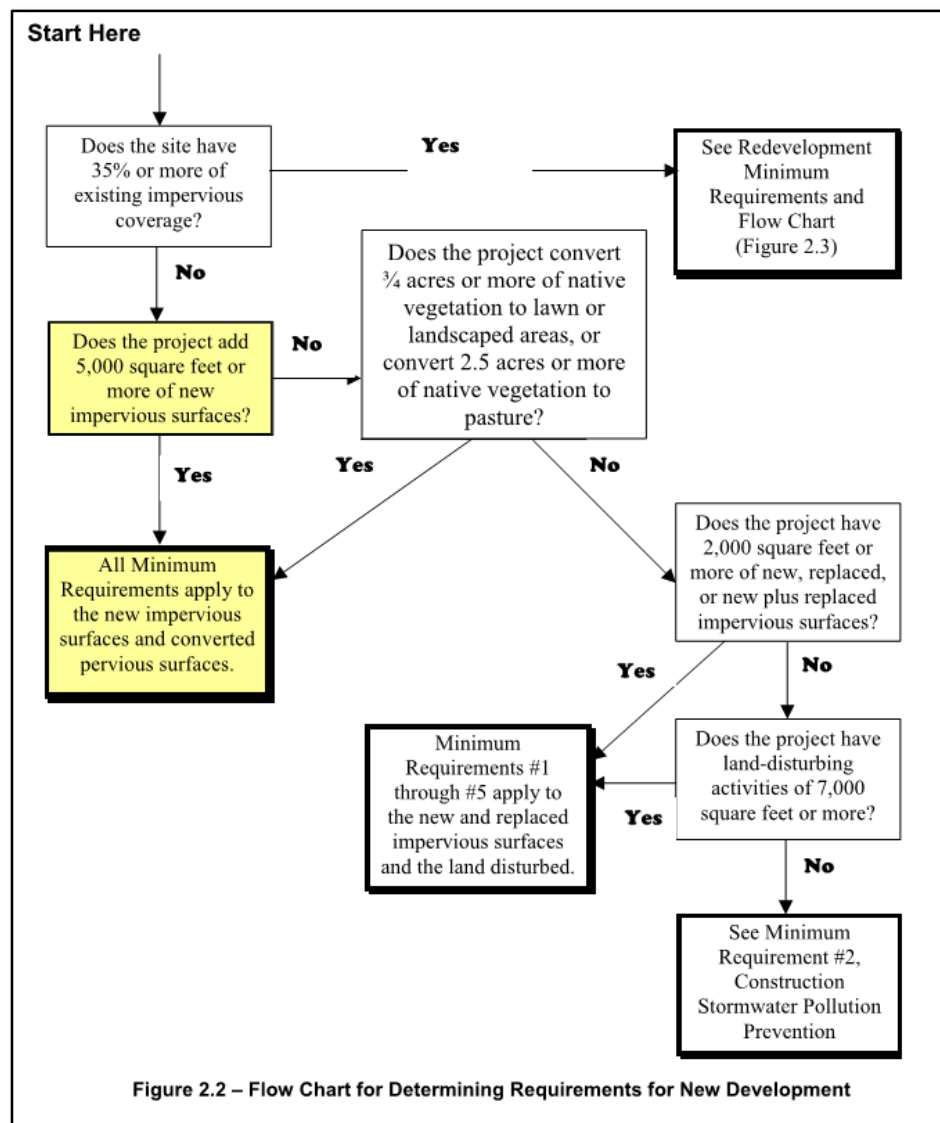
**City, County, State:** Redmond, King County, Washington State

**Governing Agency:** City of Redmond

**Design Criteria:** 2005 DOE Manual with amendments per the 2012 City of Redmond Clearing, Grading, and Stormwater Management Technical Notebook. Minimum Requirement #5 shall be addressed per the 2016 City of Redmond LID Feasibility Determination.

**Zoning:** Manufacturing Park (MP)

## MINIMUM REQUIREMENTS



### Minimum Requirement #1: Preparation of Stormwater Site Plans

All projects meeting the thresholds in Section 2.4 shall prepare a Stormwater Site Plan for local government review.

**Response:** A stormwater site plan has been prepared for the proposed development. The stormwater site plan includes the design drawings and this report.

### Minimum Requirement #2: Construction Stormwater Pollution Prevention (SWPPP)

All new development and redevelopment shall comply with Construction SWPP Elements #1 through #12. Projects in which the new, replaced, or new plus replaced impervious surfaces total 2,000 square feet or more, or disturb 7,000 square feet or more of land must prepare a Construction SWPP Plan

(SWPPP) as part of the Stormwater Site Plan. Each of the twelve elements must be considered and included in the Construction SWPPP unless site conditions render the element unnecessary and the exemption from that element is clearly justified in the narrative of the SWPPP.

Projects that add or replace less than 2,000 square feet of impervious surface or disturb less than 7,000 square feet of land are not required to prepare a Construction SWPPP, but must consider all of the twelve Elements of Construction Stormwater Pollution Prevention and develop controls for all elements that pertain to the project site.

**Response:** *The 12 elements of a SWPPP are addressed in the Construction SWPPP section of this report. A full Construction SWPPP is also included under separate cover per City of Redmond requirements.*

### **Minimum Requirement #3: Source Control of Pollution**

All known, available and reasonable source control BMPs shall be applied to all projects. Source control BMPs shall be selected, designed, and maintained according to the manual.

**Response:** *All available and reasonable source control BMPs will be applied to this project. This includes, but is not limited to the following:*

- *Dust Control at Disturbed Land Areas*
- *Landscaping and Lawn/Vegetation Management*
- *Maintenance of Stormwater Drainage and Treatment Systems*
- *Roof/Building Drains at Manufacturing and Commercial Buildings*
- *Soil Erosion and Sediment Control at Industrial Sites*

### **Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls**

Natural drainage patterns shall be maintained, and discharges from the project site shall occur at the natural location, to the maximum extent practicable. The manner by which runoff is discharged from the project site must not cause a significant adverse impact to downstream receiving waters and downgradient properties. All outfalls require energy dissipation.

**Response:** *A majority of runoff from the proposed project will discharge to an existing conveyance system located in NE 188<sup>th</sup> Street that discharges to an existing combination water quality/detention pond (Detention Pond A, Union Hill Metro) as described in the Stormwater Drainage Technical Information Report for Regional Detention Pond A, Union Hill Metro Site, by DOWL HKM, dated October 29, 2012. A small portion of the sloped area along the western boundary will continue to surface drain along its existing flow path to the west. A basin analysis is provided for this area in the Offsite Analysis section of this report.*

### **Minimum Requirement #5: On-site Stormwater Management**

The City of Redmond has two on-site stormwater management techniques requiring roof downspout control and compost amended soils in landscape areas.

Additionally, projects shall employ On-site Stormwater Management BMPs to infiltrate, disperse, and retain stormwater runoff onsite to the maximum extent feasible without causing flooding or erosion

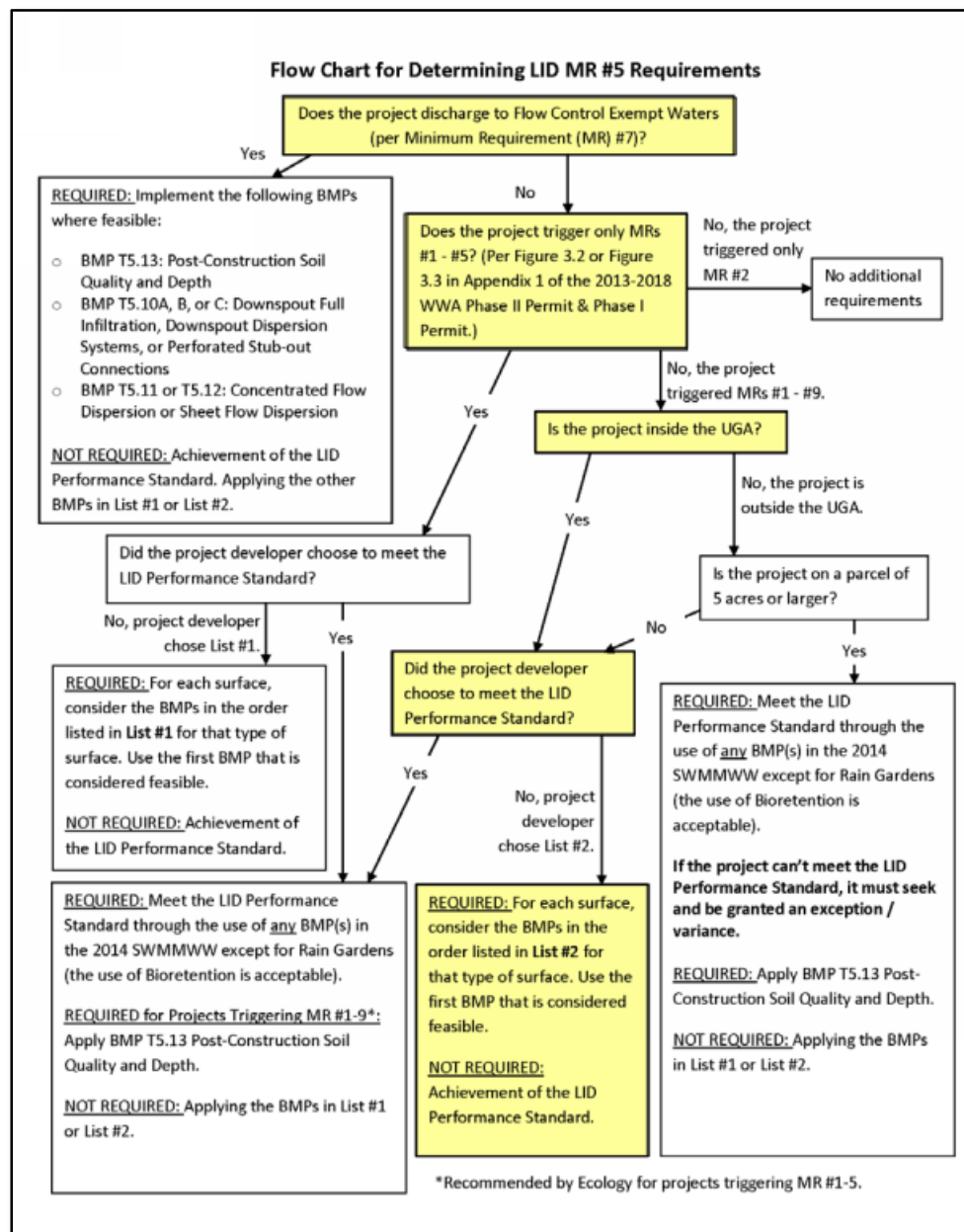
impacts. Roof Downspout Control BMPs, functionally equivalent to those described in Chapter 3 of Volume III, and Dispersion and Soil Quality BMPs, functionally equivalent to those in Chapter 5 of Volume V, shall be required to reduce the hydrologic disruption of developed sites. Project proponents are encouraged to use runoff reduction/on-site stormwater management techniques to meet flow control requirements.

Projects shall use Ecology's 2012 Stormwater Management Manual for Western Washington: Volume I of Section 2.5.5, Chapter 3 of Volume III, and Chapter 5 of Volume V to determine which on-site stormwater management BMPs shall be employed on a particular project site, and document that determination in the drainage report.

As described elsewhere in the Technical Notebook, to protect groundwater:

1. stormwater infiltration from pollution generating surfaces in wellhead protection zones 1, 2, and 3 is limited; and
2. pervious pavement shall not be used for pollution generating hard surfaces, citywide.

***Response:*** See below for the Flow Chart for Determining LID MR #5 Requirements.



*The BMPs in List #2 (below) were evaluated for feasibility for each type of surface. The first BMP that was determined feasible was selected for on-site use.*

*List #2 BMPs:*

*Lawn and Landscaped Areas:*

- **Post-Construction Soil Quality and Depth: Determined feasible.**

*Roofs:*

- *Full Dispersion: Determined infeasible due to the vegetated flowpath setbacks from the proposed walls and property line, which leaves an insufficient on-site area to provide the required vegetated pervious area.*
- *Bioretention: Determined infeasible due to insufficient on-site area to provide the required bioretention area to treat the full roof area. Additionally, bioretention would allow a significant amount of runoff to infiltrate behind the 10'-20' on-site walls, which is not an acceptable design.*
- *Downspout Dispersion Systems: Determined infeasible, as there is insufficient area to provide the required vegetated flowpath on-site with the required vegetated flowpath setbacks from the proposed walls and property line.*
- ***Perforated Stub-out Connections: Determined feasible.***

*Other Hard Surfaces:*

- *Full Dispersion: Determined infeasible, as there is insufficient area to provide the required vegetated flowpath on-site with the required vegetated flowpath setbacks from the proposed walls and property line.*
- *Permeable pavement: Determined infeasible, as the project site is located within Wellhead Protection Zone 2, in which infiltrating runoff from on-site pollution generating impervious surface is prohibited.*
- *Bioretention BMPs: Determined infeasible, as the project site is located within Wellhead Protection Zone 2, in which infiltrating runoff from on-site pollution-generating impervious surface is prohibited. Other hard surfaces (sidewalk) runoff onto pollution-generating impervious surface.*
- *Sheet Flow Dispersion: Determined infeasible, as there is insufficient area to provide the required vegetated flowpath on-site with the required vegetated flowpath setbacks from the proposed walls and property line.*

*All finished landscape areas on-site will contain compost amended soils. Roof downspout control will be provided by means of a perforated stub-out connection to the proposed on-site conveyance system that discharges off-site to the existing combination water quality/detention pond (Detention Pond A, Union Hill Metro) as described in the Stormwater Drainage Technical Information Report for Regional Detention Pond A, Union Hill Metro Site, by DOWL HKM, dated October 29, 2012.*

#### **Minimum Requirement #6: Runoff Treatment**

The following require construction of stormwater treatment facilities (see Table 2.1):

- Projects in which the total of effective, pollution-generating impervious surface (PGIS) is 5,000 square feet or more in a threshold discharge area of the project, or  
Projects in which the total of pollution-generating pervious surfaces (PGPS) is three-quarters (3/4) of an acre or more in a threshold discharge area, and from which there is a surface discharge in a natural or man-made conveyance system from the site.

- If the PGIS for a high-use site exceeds 5,000 square feet in threshold discharge area, an oil control BMP from the Oil Control Menu is necessary. High use site are characterized by the following:
  - Is subject to an expected average daily vehicle traffic (ADT) count equal to or greater than 100 vehicles per 1,000 square feet of gross building area: or
  - Is subject to storage of a fleet of 25 or more diesel vehicles that are over 10 tons gross weight (trucks, buses, trains, heavy equipment, etc.).

**Response:** *Enhanced water quality treatment for the PGIS will be provided through an existing combination detention/water quality pond (Detention Pond A, Union Hill Metro) that was adequately sized to treat runoff from the project site as described in the Stormwater Drainage Technical Information Report for Regional Detention Pond A, Union Hill Metro Site, by DOWL HKM, dated October 29, 2012. The existing pond provides detention and enhanced water quality treatment. Specifically, the existing pond was oversized to accommodate 1.5 times the base water quality treatment volume needed in order to provide for enhanced water quality treatment.*

*Per trip generation information provided by Transportation Solutions, Inc., this site will generate a maximum of 855 daily trips. With approximately 90,000 SF of gross building area, this site results in 9.5 trips per 1000 SF of building area, which is below the high-use site threshold. Therefore, this site is not considered a high-use site, and no oil control BMPs are required. See Appendix E for details regarding the daily trip generation from the Transportation Engineer.*

#### **Minimum Requirement #7: Flow Control**

Projects must provide flow control to reduce the impacts of stormwater runoff from impervious surfaces and land cover conversions. The requirement below applies to projects that discharge stormwater directly or indirectly through a conveyance system, into a fresh water.

**Response:** *Flow control for project areas will be provided through an existing combination water quality/detention pond (Detention Pond A, Union Hill Metro) that was adequately sized to handle the runoff from the project site as described in the Stormwater Drainage Technical Information Report for Regional Detention Pond A, Union Hill Metro Site, by DOWL HKM, dated October 29, 2012.*

#### **Minimum Requirement #8: Wetlands Protection**

The wetland protection requirements apply only to projects whose stormwater discharges into a wetland, either directly or indirectly through a conveyance system. These requirements must be met in addition to meeting Minimum Requirement #6, Runoff Treatment.

**Response:** *The site does not have any existing wetlands. Therefore, no wetlands will be impacted as part of this project.*

#### **Minimum Requirement #9: Basin/Watershed Planning**

Projects may be subject to equivalent or more stringent minimum requirements for erosion control, source control, treatment, and operation and maintenance, and alternative requirements for flow control and wetlands hydrologic control as identified in Basin/Watershed Plans. Basin/Watershed plans shall evaluate and include, as necessary, retrofitting urban stormwater BMPs into existing development

and/or redevelopment in order to achieve watershed-wide pollutant reduction and flow control goals that are consistent with requirements of the federal Clean Water Act. Standards developed from basin plans shall not modify any of the above minimum requirements until the basin plan is formally adopted and implemented by the local governments within the basin, and approved or concurred with by Ecology.

**Response:** *There are no Basin/Watershed Planning requirements applicable to this project.*

**Minimum Requirement #10: Operation and Maintenance**

An operation and maintenance manual that is consistent with the provisions in Volume V of the DOE manual shall be provided for all proposed stormwater facilities and BMPs, and the party (or parties) responsible for maintenance and operation shall be identified. At private facilities, a copy of the manual shall be retained onsite or within reasonable access to the site, and shall be transferred with the property to the new owner. For public facilities, a copy of the manual shall be retained in the appropriate department. A log of maintenance activity that indicates what actions were taken shall be kept and be available for inspection by the local government.

**Response:** *An Operation and Maintenance Manual is included under separate cover per City of Redmond requirements. The Operations and Maintenance Manual will be provided in the next submittal of the storm report.*

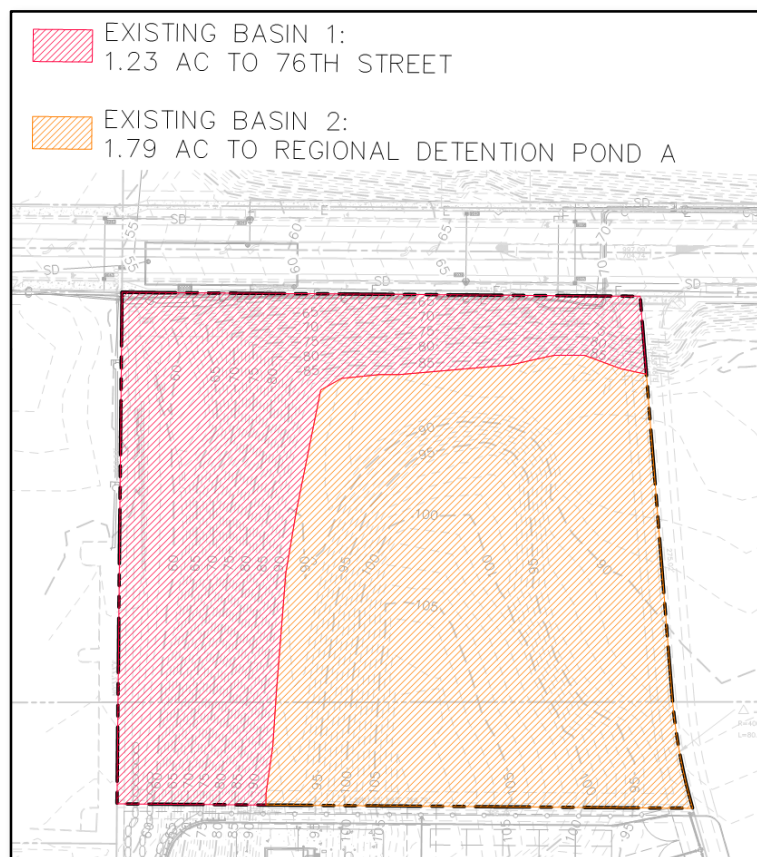
## EXISTING CONDITIONS

The proposed commercial development is located at Lot 4 of the Union Hill Corporate Center in Redmond, Washington. The subject property is 3.02 acres in size. The property is bordered by the MV Transit development to the south, a commercial development to the west, and undeveloped lots to the east and across 76<sup>th</sup> Street to the north. See Figure 1 on Page 3 for the vicinity map. See Appendix A for the Existing Conditions Exhibit.

### Pre-Development Stormwater Runoff

The property is currently undeveloped and contains two drainage basins as shown in Existing Drainage Basins Map in Figure 2 below. An existing ditch runs along the westerly base of a 15' high dirt stockpile. The ditch routes the runoff from this 1.23-acre basin to an existing sediment pond on the adjacent property to the east. The existing sediment pond outfalls to an existing 30" stub off 188<sup>th</sup> Street, which flows north through the existing conveyance system within 188<sup>th</sup> Street, ultimately discharging to the existing Regional Detention Pond A (Union Hill Metro Site).

The remaining 1.79-acre basin sheet flows down the 30' slope to a ditch along the western edge of the property, which drains into the existing conveyance system within 76<sup>th</sup> Street. See Figure 2 below for the Existing Drainage Basins.



**Figure 2: Existing Drainage Basins Map**

**Soils Conditions**

Per the Geotechnical Engineering Evaluation by Nelson Geotechnical Associates, Inc., dated February 27, 2017, on-site soil conditions consist of well-compacted fill that is characterized as generally medium dense to dense silty sand with gravel. Native recessional outwash was encountered at approximately 40 feet below the existing ground surface. In some areas, the fill extends up to 50 feet below the existing ground surface.

Groundwater was not encountered in any explorations or emitting from site slopes.

Due to the nature and thickness of the fill soils, infiltration is not recommended by the geotechnical engineer.

**DEVELOPED CONDITIONS**

The proposed development consists of a new self-storage building with associated parking and an auxiliary parking lot on a 3.02-acre site at Lot 4 of the Union Hill Corporate Center in Redmond, Washington. The site will comprise of 2.28 acres of paved asphalt and sidewalks. The property is zoned MP (Manufacturing Park).

See Appendix A for the Developed Conditions Exhibit.

**Post-Development Stormwater Runoff**

Stormwater will be managed on the project site in accordance with the 2005 DOE Manual and amendments per the 2012 City of Redmond Technical Notebook.

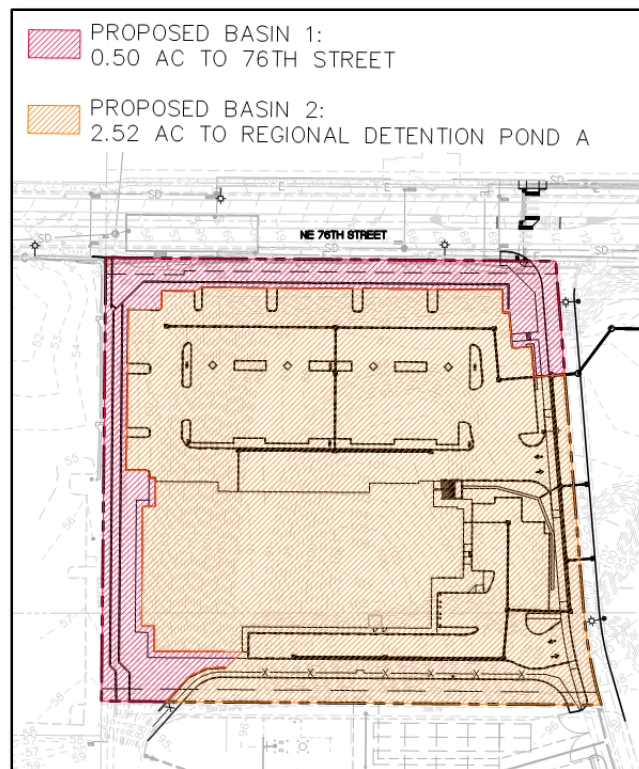
The existing Regional Detention Pond A (Union Hill Metro Site), located northwest of the project site, was designed and constructed to provide flow control and enhanced water quality treatment for runoff flows from the Union Hill Corporate Center Short Plat, including runoff from the project site (Lot 4 of the short plat). As described in the Stormwater Drainage Technical Information Report for Regional Detention Pond A, Union Hill Metro Site, by DOWL HKM, dated October 29, 2012, the project site is allowed to contribute up to 60% pollution-generating impervious area (1.81 acres PGIS) in addition to 20% non-pollution generating impervious area (0.60 acres NPGIS) and 20% landscaping/pervious surface area (0.60 acres).

In the developed condition, 2.35 acres of impervious surface area (1.53 acres PGIS; 0.82 acres NPGIS) and 0.17 acres of pervious surface area will be tributary to the existing pond. These areas are within the existing pond capacity design thresholds of 2.41 acres of impervious (1.81 acres PGIS; 0.60 acres NPGIS) and 0.60 acres of pervious described above. Therefore, the existing pond has sufficient capacity to accommodate both water quality treatment and flow control for this development. See the Permanent Stormwater Control Plan section for further details.

Site runoff will be conveyed through a network of catch basins and closed conveyance pipes to the existing 30" storm main stub that was previously installed off of 188<sup>th</sup> Avenue NE. This 30" storm main will convey the site stormwater to the existing combination water quality/detention pond (Detention Pond A, Union Hill Metro) for water quality treatment and flow control.

The remaining 0.50 acres of pervious surface area, which is comprised primarily of the western and northern retaining walls and associated landscape area, will continue to outfall to the west into the existing municipal storm system in 76<sup>th</sup> Street. Per the wall design by Nelson Geotechnical Associates, Inc., a perforated drainage pipe is included for the lower of the two tiered walls. This wall drain is connected to the wall drain for the single tiered wall along the northern property boundary. These wall drains are routed via a single closed conveyance pipe to an existing cleanout that is stubbed out from 76<sup>th</sup> Street.

See Figure 3 for the Proposed Drainage Basins.



**Figure 3: Proposed Drainage Basins**



### OFFSITE ANALYSIS

The upstream and downstream analyses were performed on January 15, 2016.

The upstream property, MV Transit, was developed in 2016, after the site survey was conducted. In the current site conditions, there is no upstream runoff from the MV Transit site onto the project site.


The site has a steep slope along the western property line that varies from 25-30 feet of elevation gain. In the existing condition, approximately 1.79 acres of on-site stormwater runoff is tributary to an existing ditch that runs north along the western property boundary. The ditch disperses runoff to the property to the west, where it ultimately drains into the conveyance system in 76<sup>th</sup> Street. In the developed condition along the western boundary where the new retaining walls will be constructed, this tributary area will be reduced to approximately 0.50 acres of runoff.

An existing ditch runs along the westerly base of a 15' high dirt stockpile located approximately in the center of the site. The ditch routes the runoff from this 1.23-acre basin to an existing sediment pond on the adjacent property to the east. The existing sediment pond outfalls to an existing 30" stub off 188<sup>th</sup> Street, which flows north through the existing conveyance system within 188<sup>th</sup> Street, ultimately discharging to an existing combination water quality/detention pond (Detention Pond A, Union Hill Metro) as described in the Stormwater Drainage Technical Information Report for Regional Detention Pond A, Union Hill Metro Site, by DOWL HKM, dated October 29, 2012.

#	Photo	Description
1		<p>Looking northeast from the stockpile</p> <p>On-site stormwater runoff flows into a ditch that runs from the site onto the adjacent property to the east.</p>
2		<p>Looking west from 188<sup>th</sup> to the adjacent property (east of the project site).</p> <p>The ditch outfalls into a temporary pond on the adjacent property with a gravel cone riser.</p>

3		<p>Looking east from the temporary pond.</p> <p>The pond outfall connects to the existing 30" pipe, which runs north along 188<sup>th</sup> to the existing Regional Detention Pond A.</p>
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The remaining stormwater sheet flows down the 30' slope to a ditch along the west of the property and runs off into the existing system of catch basins and pipes in 76<sup>th</sup> Street. See Appendix A for the Existing Drainage Basins Exhibit (To be included in the next submittal of the storm report).

#	Photo	Description
1		<p>Looking east from the northwest corner of the site.</p> <p>On-site stormwater runoff from the slopes sheet flows down across the sidewalk and is collected by the catch basin in 76<sup>th</sup> Street.</p>
2		<p>Looking west near the northwest corner of the site.</p> <p>The catch basin is tightlined to a vault under 76<sup>th</sup> Street for treatment and detention. The detained flow leaves the vault and flows</p>



## PERMANENT STORMWATER CONTROL PLAN

### EXISTING SITE HYDROLOGY

Per the 2005 DOE requirements, the pre-developed conditions for the project site have been modeled as completely forested as shown in Table 2, below. The total site is 3.02 acres. See Appendix A for the Existing Conditions Exhibit.

**Table 2**

<b>Existing Conditions</b>		
<b>Basin Area (AC)</b>	<b>Description</b>	<b>Grade</b>
3.02	Forest (Pervious)	Moderate
<b>3.02</b>	<b>Total Existing Conditions</b>	

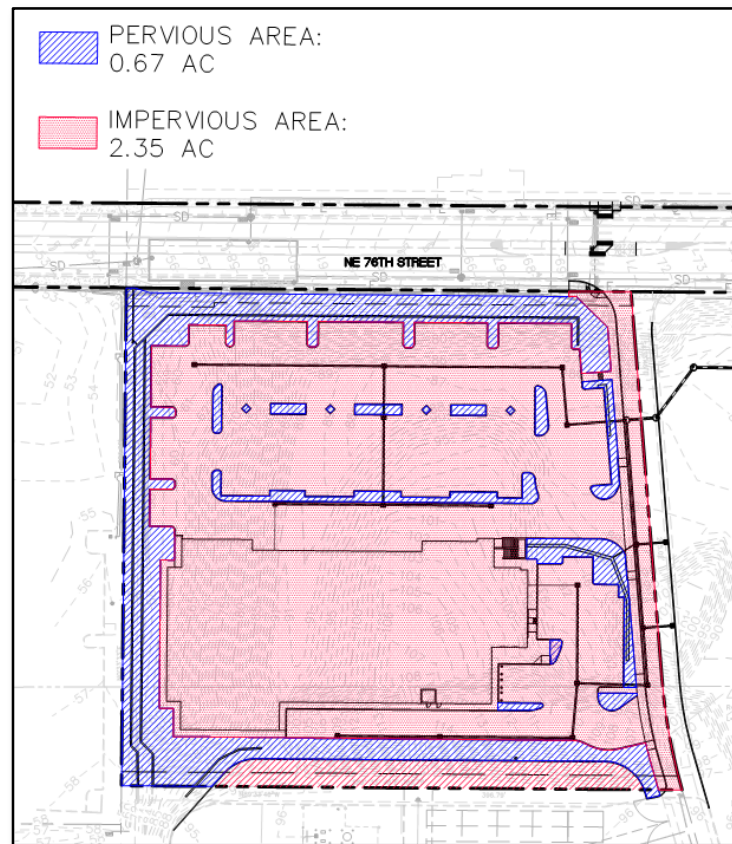
### DEVELOPED SITE HYDROLOGY

All site areas are delineated in the Developed Conditions Exhibit, which can be found in Appendix A of this report. The contributing site area routed to the regional detention pond are shown in Table 3.

**Table 3**

<b>Developed Conditions – To Regional Detention Pond</b>		
<b>Area (AC)</b>	<b>Description</b>	<b>Grade</b>
0.67	Landscaping	Moderate
0.82	Building (30,838 SF) and sidewalks	Flat
1.43	Parking lots	Flat
0.10	Private road (within property limits)	Moderate
<b>0.67</b>	<b>Total Pervious</b>	
<b>2.35</b>	<b>Total Impervious</b>	
<b>3.02</b>	<b>Total Site Area</b>	

See Figure 4 for the Developed Conditions. See Appendix A for the Developed Conditions Exhibit.



**Figure 4: Proposed Conditions**

#### **NEARBY RECEIVING WATERS**

There are no nearby receiving waters that will be negatively impacted by this project. All runoff from the project will be ultimately discharged into Bear Creek approximately 1 mile downstream of the project site.

#### **HYDROLOGIC MODELING**

Flow control and enhanced treatment will be provided by an existing combination water quality/detention pond (Detention Pond A, Union Hill Metro) as described in the Stormwater Drainage Technical Information Report for Regional Detention Pond A, Union Hill Metro Site, by DOWL HKM, dated October 29, 2012. Hydrologic modeling was performed for conveyance sizing.

#### **FLOW CONTROL SYSTEM**

As described in the Stormwater Drainage Technical Information Report for Regional Detention Pond A, Union Hill Metro Site, by DOWL HKM, dated October 29, 2012 (Pond A TIR), the existing Regional Detention Pond A was designed and constructed to provide flow control for runoff flows from the Union Hill Corporate Center Short Plat. This project site is included in the design of the regional pond's contributing area (Lot 4); therefore, the on-site runoff will be routed to the existing Regional Detention Pond A for flow control in accordance with the design.

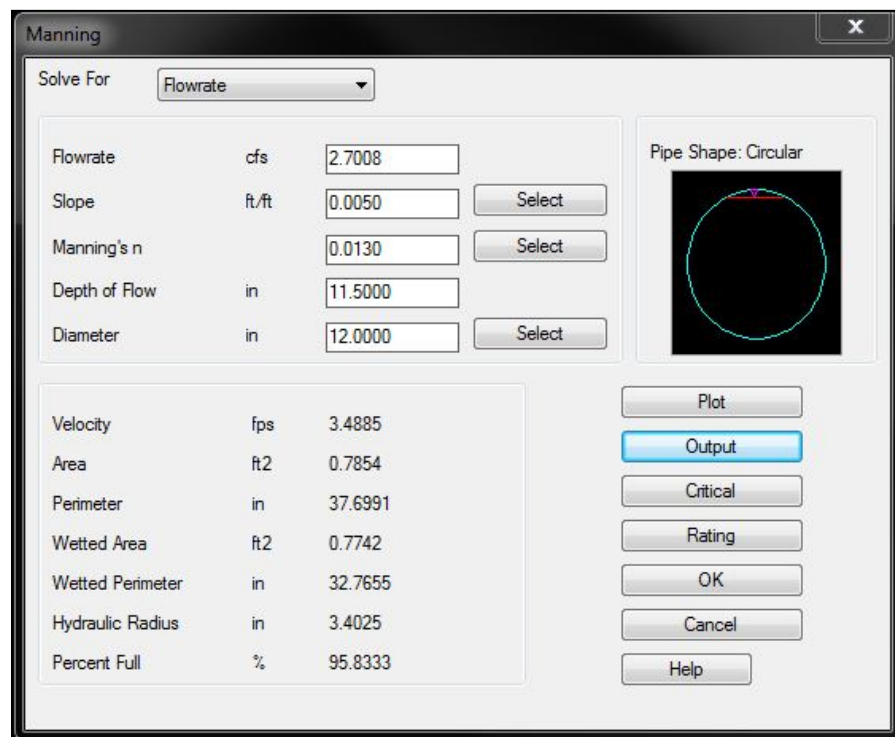
Per the Pond A TIR, the regional pond was provisioned for the project site to contribute up to 60% pollution-generating impervious area (1.81 acres) in addition to 20% non-pollution generating impervious area (0.60 acres) and 20% landscaping (0.60 acres).

### WATER QUALITY SYSTEM

The existing regional detention pond was designed to provide enhanced treatment for up to 1.81 acres of the pollution-generating impervious area from the project site. Approximately 1.53 acres of pollution-generating impervious area is proposed to be routed to the existing regional detention pond for enhanced treatment, which is below the designed threshold for this site. No additional water quality treatment measures are necessary or proposed for this project.

### CONVEYANCE SYSTEM ANALYSIS AND DESIGN

In the main conveyance system, the proposed 12-inch diameter pipe at 0.5% minimum slope is the most restrictive element. As demonstrated in the Figure 4, this element can provide conveyance capacity up to 2.70 cfs flowing near full, which is more than enough capacity to handle the 100-year, 24-hour peak flow from the 3.02-acre disturbed area of 2.00 cfs.



The image shows a software dialog box titled "Manning" with a close button (X) in the top right corner. The "Solve For" dropdown menu is set to "Flowrate". The input fields are: Flowrate (cfs) = 2.7008, Slope (ft/ft) = 0.0050, Manning's n = 0.0130, Depth of Flow (in) = 11.5000, and Diameter (in) = 12.0000. Each input field has a "Select" button to its right. On the right side, there is a section for "Pipe Shape: Circular" with a circular diagram showing a water surface profile. Below the input fields, a table displays calculated values: Velocity (fps) = 3.4885, Area (ft2) = 0.7854, Perimeter (in) = 37.6991, Wetted Area (ft2) = 0.7742, Wetted Perimeter (in) = 32.7655, Hydraulic Radius (in) = 3.4025, and Percent Full = 95.8333. On the right side of the dialog, there are buttons for "Plot", "Output", "Critical", "Rating", "OK", "Cancel", and "Help".

Parameter	Unit	Value
Flowrate	cfs	2.7008
Slope	ft/ft	0.0050
Manning's n		0.0130
Depth of Flow	in	11.5000
Diameter	in	12.0000
Velocity	fps	3.4885
Area	ft2	0.7854
Perimeter	in	37.6991
Wetted Area	ft2	0.7742
Wetted Perimeter	in	32.7655
Hydraulic Radius	in	3.4025
Percent Full	%	95.8333

Figure 4: Manning's Calculation for Twelve-Inch Pipe

**100-YEAR FLOOD/OVERFLOW CONDITION**

The stormwater conveyance system for this project has been designed to address storm events in accordance with common industry practices. In the event of a larger storm, the system may fail. In this case, the runoff from larger events will overflow along NE 188<sup>th</sup> Street and the westerly property line. The overflow of the regional detention pond is described in the Pond A TIR.

## CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN

All erosion and sediment control measures shall be governed by the requirements of the City of Redmond. A temporary erosion and sedimentation control plan has been prepared and full CSWPPP will be provided prior to construction.

### TWELVE ELEMENTS OF CSWPPP

#### Element 1: Mark Clearing Limits

- Prior to beginning land disturbing activities, including clearing and grading, all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within the construction area shall be clearly marked, both in the field and on the plans, to prevent damage and offsite impacts.
- Plastic, metal, or stake wire fence may be used to mark the clearing limits.
- The duff layer, native top soil, and natural vegetation shall be retained in an undisturbed state to the maximum extent practicable. If it is not practicable to retain the duff layer in place, it should be stockpiled on-site, covered to prevent erosion, and replaced immediately upon completion of the ground disturbing activities.

#### Element 2: Establish Construction Access

- Construction vehicle access and exit shall be limited to one route, if possible, or two for linear projects such as roadways where more than one access is necessary for large equipment maneuvering.
- Access points shall be stabilized with a pad of quarry spalls or crushed rock prior to traffic leaving the construction site to minimize the tracking of sediment onto public roads.
- Wheel wash or tire baths should be located on-site, if applicable.
- If sediment is tracked off site, public roads shall be cleaned thoroughly at the end of each day, or more frequently during wet weather, if necessary to prevent sediment from entering waters of the state. Sediment shall be removed from roads by shoveling or pickup sweeping and shall be transported to a controlled sediment disposal area. Street washing will be allowed only after sediment is removed in this manner.
- Street wash wastewater shall be controlled by pumping back onsite, or otherwise be prevented from discharging into systems tributary to state surface waters.

#### Element 3: Control Flow Rates

- Properties and waterways downstream from development sites shall be protected from erosion due to increases in the volume, velocity, and peak flow rate of stormwater runoff from the project site, as required by local plan approval authority.
- Downstream analysis is necessary if changes in flows could impair or alter conveyance systems, stream banks, bed sediment or aquatic habitat.
- Where necessary to comply with Minimum Requirement #7, stormwater retention/detention facilities shall be constructed as one of the first steps in grading. Detention facilities shall be functional prior to construction of site improvements (e.g. impervious surfaces).
- The local permitting agency may require pond designs that provide additional or different stormwater flow control if necessary to address local conditions or to protect properties and waterways downstream from erosion due to increases in the volume, velocity, and peak flow rate of stormwater runoff from the project site.

- 
- If permanent infiltration ponds are used for flow control during construction, these facilities should be protected from siltation during the construction phase.

**Element 4: Install Sediment Controls**

- Prior to leaving a construction site, or prior to discharge to an infiltration facility, stormwater runoff from disturbed areas shall pass through a sediment pond or other appropriate sediment removal BMP. Runoff from fully stabilized areas may be discharged without a sediment removal BMP, but must meet the flow control performance standard of Element #3, bullet #1. Full stabilization means concrete or asphalt paving; quarry spalls used as ditch lining; or the use of rolled erosion products, a bonded fiber matrix product, or vegetative cover in a manner that will fully prevent soil erosion. The Local Permitting Authority shall inspect and approve areas stabilized by means other than pavement or quarry spalls.
- Sediment ponds, vegetated buffer strips, sediment barriers or filters, dikes, and other BMPs intended to trap sediment on-site shall be constructed as one of the first steps in grading. These BMPs shall be functional before other land disturbing activities take place.
- Earthen structures such as dams, dikes, and diversions shall be seeded and mulched according to the timing indicated in Element #5.
- BMPs intended to trap sediment on site must be located in a manner to avoid interference with the movement of juvenile salmonids attempting to enter off-channel areas or drainages, often during non-storm events, in response to rain event changes in stream elevation or wetted area.

**Element 5: Stabilize Soils**

- All exposed and unworked soils shall be stabilized by application of effective BMPs that protect the soil from the erosive forces of raindrop impact and flowing water, and wind erosion.
- From October 1 through April 30, no soils shall remain exposed and unworked for more than 2 days. From May 1 to September 30, no soils shall remain exposed and unworked for more than 7 days. This condition applies to all soils on site, whether at final grade or not. These time limits may be adjusted by the local permitting authority if it can be shown that the average time between storm events justifies a different standard.
- Soils shall be stabilized at the end of the shift before a holiday or weekend if needed based on the weather forecast.
- Applicable practices include, but are not limited to, temporary and permanent seeding, sodding, mulching, plastic covering, soil application of polyacrylamide (PAM), the early application of gravel base on areas to be paved, and dust control.
- Soil stabilization measures selected should be appropriate for the time of year, site conditions, estimated duration of use, and potential water quality impacts that stabilization agents may have on downstream waters or ground water.
- Soil stockpiles must be stabilized from erosion, protected with sediment trapping measures, and when possible, be located away from storm drain inlets, waterways and drainage channels.
- Linear construction activities, including right-of-way and easement clearing, roadway development, pipelines, and trenching for utilities, shall be conducted to meet the soil stabilization requirement. Contractors shall install the bedding materials, roadbeds, structures, pipelines, or utilities and re-stabilize the disturbed soils so that:
  - from October 1 through April 30 no soils shall remain exposed and unworked for more than 2 days; and
  - from May 1 to September 30, no soils shall remain exposed and unworked for more than 7 days.

**Element 6: Protect Slopes**

- Cut and fill slopes shall be designed and constructed in a manner that will minimize erosion.
- Consider soil type and its potential for erosion.
- Reduce slope runoff velocities by reducing the continuous length of slope with terracing and diversions, reduce slope steepness, and roughen slope surface.
- Off-site stormwater (run-on) shall be diverted away from slopes and disturbed areas with interceptor dikes and/or swales. Off-site stormwater should be managed separately from stormwater generated on the site.
- At the top of slopes, collect drainage in pipe slope drains or protected channels to prevent erosion. Temporary pipe slope drains shall handle the peak flow from a 10 year, 24 hour event assuming a Type 1A rainfall distribution. Alternatively, the 10-year and 25-year, 1-hour flow rates indicated by an approved continuous runoff model, increased by a factor of 1.6, may be used. Consult the local drainage requirements for sizing permanent pipe slope drains.
- Provide drainage to remove ground water intersecting the slope surface of exposed soil areas.
- Excavated material shall be placed on the uphill side of trenches, consistent with safety and space considerations.
- Check dams shall be placed at regular intervals within channels that are cut down a slope.
- Stabilize soils on slopes, as specified in Element #5.

**Element 7: Protect Drain Inlets**

- All storm drain inlets made operable during construction shall be protected so that stormwater runoff shall not enter the conveyance system without first being filtered or treated to remove sediment.
- All approach roads shall be kept clean. All sediment and street wash water shall not be allowed to enter storm drains without prior and adequate treatment unless treatment is provided before the storm drain discharges to waters of the State.
- Inlets should be inspected weekly at a minimum and daily during storm events. Inlet protection devices should be cleaned or removed and replaced when sediment has filled one-third of the available storage (unless a different standard is specified by the product manufacturer).

**Element 8: Stabilize Channels and Outlets**

- All temporary on-site conveyance channels shall be designed, constructed and stabilized to prevent erosion from the expected peak 10 minute velocity of flow from a Type 1A, 10- year, 24-hour frequency storm for the developed condition. Alternatively, the 10-year, 1-hour flow rate indicated by an approved continuous runoff model, increased by a factor of 1.6, may be used.
- Stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes and downstream reaches shall be provided at the outlets of all conveyance systems.

**Element 9: Control Pollutants**

- All pollutants, including waste materials and demolition debris, that occur on-site shall be handled and disposed of in a manner that does not cause contamination of stormwater. Woody debris may be chopped and spread on site.
- Cover, containment, and protection from vandalism shall be provided for all chemicals, liquid products, petroleum products, and non-inert wastes present on the site (see Chapter 173-304 WAC for the definition of inert waste). On-site fueling tanks shall include secondary containment.
- Maintenance and repair of heavy equipment and vehicles involving oil changes, hydraulic system drain down, solvent and de-greasing cleaning operations, fuel tank drain down and removal, and

other activities which may result in discharge or spillage of pollutants to the ground or into stormwater runoff must be conducted using spill prevention measures, such as drip pans. Contaminated surfaces shall be cleaned immediately following any discharge or spill incident. Emergency repairs may be performed on-site using temporary plastic placed beneath and, if raining, over the vehicle.

- Wheel wash or tire bath wastewater, shall be discharged to a separate on-site treatment system or to the sanitary sewer.
- Application of agricultural chemicals, including fertilizers and pesticides, shall be conducted in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Manufacturers' recommendations for application rates and procedures shall be followed.
- BMPs shall be used to prevent or treat contamination of stormwater runoff by pH modifying sources. These sources include, but are not limited to, bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed aggregate processes, and concrete pumping and mixer washout waters. Stormwater discharges shall not cause or contribute to a violation of the water quality standard for pH in the receiving water.
- Construction sites with significant concrete work shall adjust the pH of stormwater if necessary to prevent violations of water quality standards.

**Element 10: Control De-Watering**

- Foundation, vault, and trench de-watering water, which has similar characteristics to stormwater runoff at the site, shall be discharged into a controlled conveyance system prior to discharge to a sediment trap or sediment pond. Channels must be stabilized, as specified in Element #8.
- Clean, non-turbid de-watering water, such as well-point ground water, can be discharged to systems tributary to state surface waters, as specified in Element #8, provided the de-watering flow does not cause erosion or flooding of receiving waters. These clean waters should not be routed through a stormwater sediment pond.
- Highly turbid or otherwise contaminated dewatering water, such as from construction equipment operation, clamshell digging, concrete tremie pour, or work inside a cofferdam, shall be handled separately from stormwater.
- Other disposal options, depending on site constraints, may include: 1) infiltration, 2) transport off-site in a vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters, 3) Ecology-approved on-site chemical treatment or other suitable treatment technologies, 4) sanitary sewer discharge with local sewer district approval, if there is no other option, or 5) use of a sedimentation bag with outfall to a ditch or swale for small volumes of localized dewatering.

**Element 11: Maintain BMPs**

- All temporary and permanent erosion and sediment control BMPs shall be maintained and repaired as needed to assure continued performance of their intended function. All maintenance and repair shall be conducted in accordance with BMP specifications.
- All temporary erosion and sediment control BMPs shall be removed within 30 days after final site stabilization is achieved or after the temporary BMPs are no longer needed. Trapped sediment shall be removed or stabilized on site. Disturbed soil areas resulting from removal of BMPs or vegetation shall be permanently stabilized.

**Element 12: Manage the Project**

- Phasing of Construction - Development projects shall be phased where feasible in order to prevent soil erosion and, to the maximum extent practicable, the transport of sediment from the site during

construction. Re-vegetation of exposed areas and maintenance of that vegetation shall be an integral part of the clearing activities for any phase.

- Clearing and grading activities for developments shall be permitted only if conducted pursuant to an approved site development plan (e.g., subdivision approval) that establishes permitted areas of clearing, grading, cutting, and filling. When establishing these permitted clearing and grading areas, consideration should be given to minimizing removal of existing trees and minimizing disturbance/compaction of native soils except as needed for building purposes. These permitted clearing and grading areas and any other areas required to preserve critical or sensitive areas, buffers, native growth protection easements, or tree retention areas as may be required by local jurisdictions, shall be delineated on the site plans and the development site.
- Seasonal Work Limitations - From October 1 through April 30, clearing, grading, and other soil disturbing activities shall only be permitted if shown to the satisfaction of the local permitting authority that silt-laden runoff will be prevented from leaving the site through a combination of the following:
  1. Site conditions including existing vegetative coverage, slope, soil type and proximity to receiving waters; and
  2. Limitations on activities and the extent of disturbed areas; and
  3. Proposed erosion and sediment control measures.

Based on the information provided and/or local weather conditions, the local permitting authority may expand or restrict the seasonal limitation on site disturbance. The local permitting authority shall take enforcement action - such as a notice of violation, administrative order, penalty, or stop-work order under the following circumstances:

- If, during the course of any construction activity or soil disturbance during the seasonal limitation period, sediment leaves the construction site causing a violation of the surface water quality standard; or
- If clearing and grading limits or erosion and sediment control measures shown in the approved plan are not maintained.

The following activities are exempt from the seasonal clearing and grading limitations:

1. Routine maintenance and necessary repair of erosion and sediment control BMPs;
  2. Routine maintenance of public facilities or existing utility structures that do not expose the soil or result in the removal of the vegetative cover to soil; and
  3. Activities where there is one hundred percent infiltration of surface water runoff within the site in approved and installed erosion and sediment control facilities.
- Coordination with Utilities and Other Contractors - The primary project proponent shall evaluate, with input from utilities and other contractors, the stormwater management requirements for the entire project, including the utilities, when preparing the Construction SWPPP.
- Inspection and Monitoring - All BMPs shall be inspected, maintained, and repaired as needed to assure continued performance of their intended function. Site inspections shall be conducted by a person who is knowledgeable in the principles and practices of erosion and sediment control. The person must have the skills to 1) assess the site conditions and construction activities that could impact the quality of stormwater, and 2) assess the effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges.
- For construction sites one acre or larger that discharge stormwater to surface waters of the state, a Certified Erosion and Sediment Control Specialist shall be identified in the Construction SWPPP and

shall be on-site or on-call at all times. Certification may be obtained through an approved training program that meets the erosion and sediment control training standards established by Ecology. Whenever inspection and/or monitoring reveals that the BMPs identified in the Construction SWPPP are inadequate, due to the actual discharge of or potential to discharge a significant amount of any pollutant, appropriate BMPs or design changes shall be implemented as soon as possible.

- Maintaining an Updated Construction SWPPP - The Construction SWPPP shall be retained on-site or within reasonable access to the site.

The SWPPP shall be modified whenever there is a significant change in the design, construction, operation, or maintenance at the construction site that has, or could have, a significant effect on the discharge of pollutants to waters of the state.

The SWPPP shall be modified, if during inspections or investigations conducted by the owner/operator, or the applicable local or state regulatory authority, it is determined that the SWPPP is ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site. The SWPPP shall be modified as necessary to include additional or modified BMPs designed to correct problems identified. Revisions to the SWPPP shall be completed within seven (7) calendar days following the inspection.

## **ESC ANALYSIS AND DESIGN**

### **Trapping Sediment**

Structural control measures will be used to reduce erosion and retain sediment on the construction site. The control measures will be selected to fit specific site and seasonal conditions.

The following structural items will be used to control erosion and sedimentation processes:

- Stabilized construction entrances
- Filter fabric fences
- Catch Basin Inlet Sediment Protection
- Proper Cover measures
- Temporary swales
- Sediment pond and Trap
- Rock check dam

Weekly inspection of the erosion control measures will be required during construction. Any sediment buildup shall be removed and disposed of off-site. Vehicle tracking of mud off-site shall be avoided. Installation of a stabilized construction entrance will be installed at a location to enter the site. The entrances are a minimum requirement and may be supplemented if tracking of mud onto public streets becomes excessive. In the event that mud is tracked off site, it shall be swept up and disposed of off-site on a daily basis. Depending on the amount of tracked mud, a vehicle road sweeper may be required.

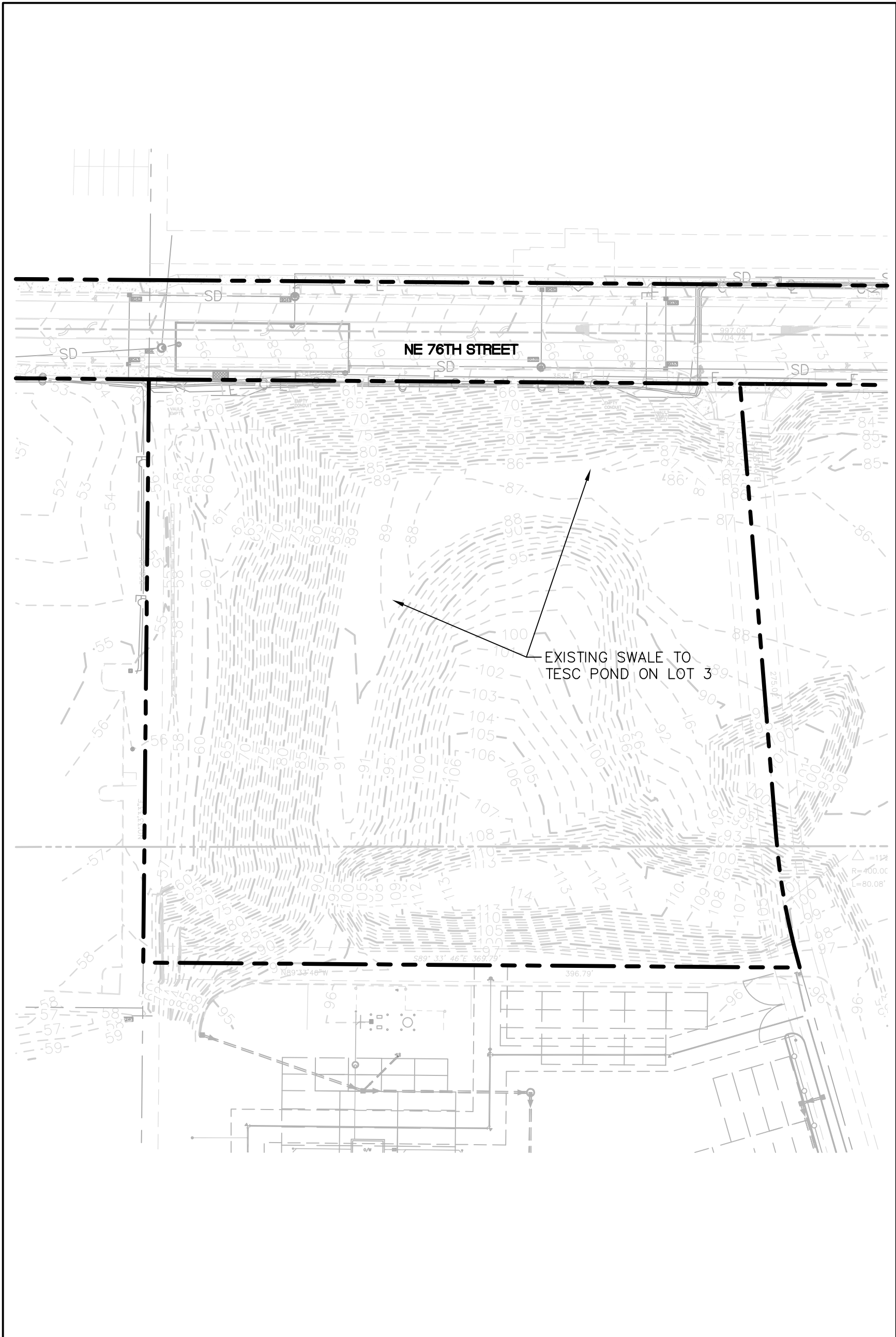
Because vegetative cover is the most important form of erosion control, construction practices must adhere to stringent cover requirements. More specifically, the contractor will not be allowed to leave soils open for more than 14 days and, in some cases, immediate seeding will be required.

**Temporary Sediment Facilities**

The design for temporary sediment facilities will be provided in the next submittal of the storm report.

# APPENDIX A

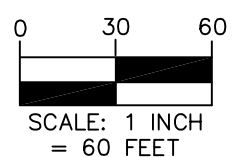
## SITE EXHIBITS

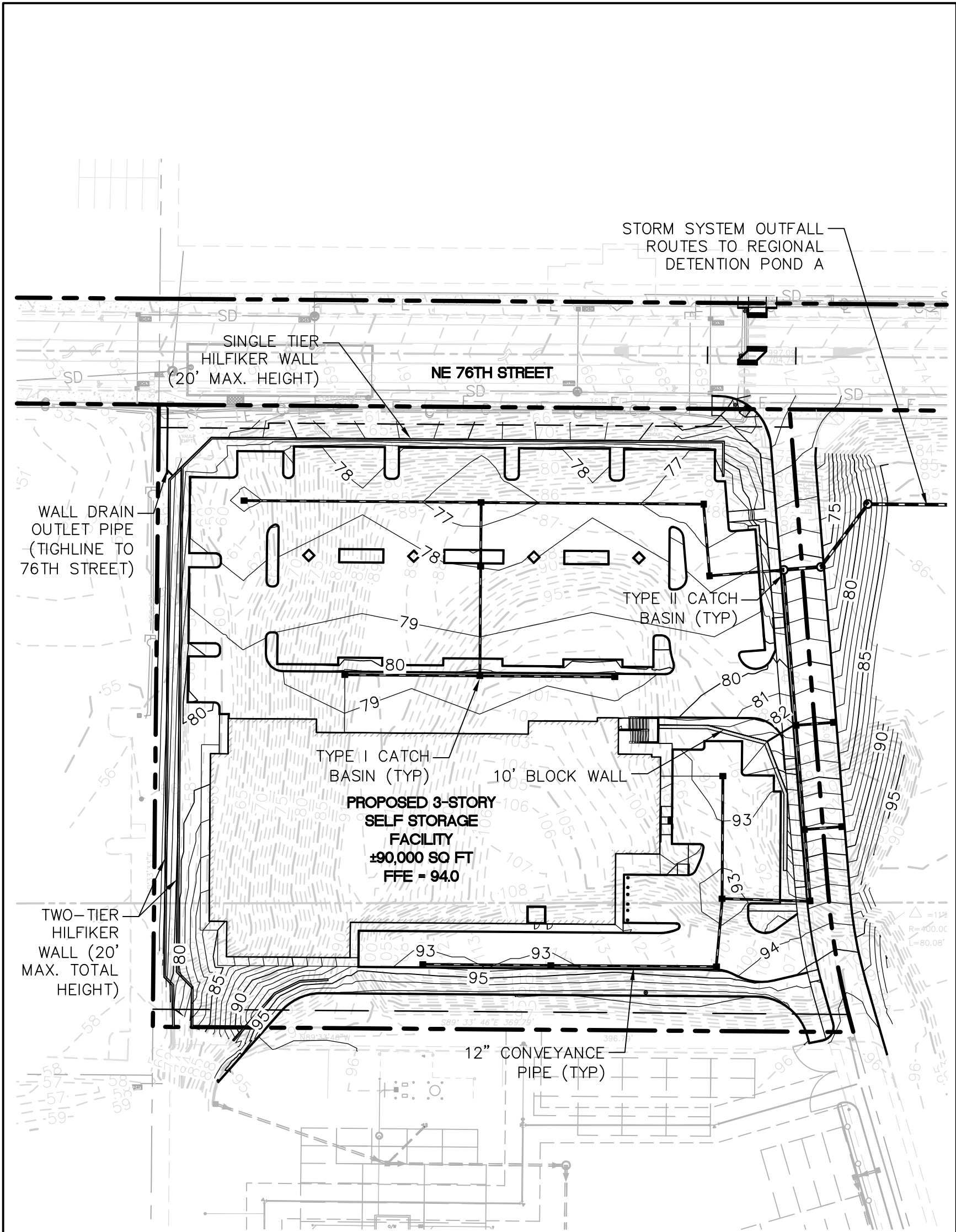


11400 s.e. 8th st, t: 425.453.9501  
suite 345 www.navixeng.com  
bellevue, wa 98004

# UNION HILL SELF-STORAGE AND AUXILLARY PARKING LOT REDMOND, WA EXISTING CONDITIONS

**2/28/2017**





# APPENDIX B

OPERATION AND MAINTENANCE MANUAL  
(TO BE PROVIDED IN THE NEXT SUBMITTAL OF THE STORM REPORT)

# APPENDIX C

CONVEYANCE SYSTEM BACKWATER ANALYSIS  
(TO BE PROVIDED IN THE NEXT SUBMITTAL OF THE STORM REPORT)

# APPENDIX D

**GEOTECHNICAL REPORT  
(SUBMITTED UNDER SEPARATE COVER)**

# APPENDIX E

## DAILY TRIP GENERATION

**From:** J.J. Engler [<mailto:jjengler@seaconllc.com>]

**Sent:** Wednesday, July 27, 2016 6:49 AM

**To:** Jenelle Taflin <[jtaflin@pacland.com](mailto:jtaflin@pacland.com)>

**Subject:** Fwd: Union Hill Self-Storage & Costco Employee Parking

Daily traffic counts for Lot 4

---

**J.J. Engler**

Project Manager

SEACON LLC

Cell: [\(425\) 495-6591](tel:(425)495-6591)

Office: [\(425\) 837-9720](tel:(425)837-9720)

Fax: [\(425\) 837-1585](tel:(425)837-1585)

Begin forwarded message:

**From:** "Jeffrey Hee" <[jeffh@tsinw.com](mailto:jeffh@tsinw.com)>

**To:** "J.J. Engler" <[jjengler@seaconllc.com](mailto:jjengler@seaconllc.com)>, "Bob Power" <[bpower@seaconllc.com](mailto:bpower@seaconllc.com)>

**Cc:** "Jenelle Taflin" <[jtaflin@pacland.com](mailto:jtaflin@pacland.com)>, "David Markley" <[davidm@tsinw.com](mailto:davidm@tsinw.com)>

**Subject: FW: Union Hill Self-Storage & Costco Employee Parking**

J.J. and Bob

Please find a copy of Costco's site plan attached.

RE: Daily Trip Generation

- 90,000 sf Self-Storage, using ITE data, generates 225 daily trips (seems high)
- 124 Costco Employee parking stalls
  1. In general, a Costco generates about 12,000 trips per day (including employees)
  2. Assume 3 employee shifts
  3. 1 work shift = 2 trips (one in and on out)
  4. Assume the employee lot will be 70% to 85% full
  5. Result: 520 to 630 daily trips (we can confirm with Costco)
- 745 and 855 daily trips (#s are rounded up)

PREP:

- I spoke with Min Luo over the phone and confirmed that the traffic impact related to development of this site are covered under the Taylor-Magnussen Development Agreement.
- I am still working through the crosswalk evaluation. I have a crew setting out tubes to collect data tomorrow and am coordinating with Ferguson so their workers know the tube is out there.

Jeff

TSI

425-883-4134 x 123